

THIS OPINION WAS NOT WRITTEN FOR PUBLICATION

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 25

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE BOARD OF PATENT APPEALS  
AND INTERFERENCES

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Ex parte TETSUO SANO,  
HIDEAKI MOTOHASHI, AND  
KOKICHI FURUHAMA

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Appeal No. 1999-1778  
Application No. 08/888,365

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HEARD: January 27, 2000

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Before STAAB, NASE AND GONZALES, Administrative Patent Judges.  
STAAB, Administrative Patent Judge.

This is an appeal from the examiner's decision twice rejecting claims 1, 2, 4-7, 9-11, 13-15 and 24-28. Claims 16-23, the only other claims remaining in the application, have been withdrawn from consideration pursuant to 37 CFR § 1.142(b) as not readable on the elected invention.

Appellants' invention pertains to heat exchanger tubes used in the construction of heat exchangers. More particularly, the

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invention relates to the configuration of the inner surface of the heat exchanger tubes. According to appellants, the present invention provides a new configuration on the inner surface of a heat exchanger tube that improves heat transfer efficiency. Independent claim 1, a copy of which is found in an appendix to appellants' brief, is illustrative of the appealed subject matter.

The following references of record are relied upon by the examiner in support of rejections under 35 U.S.C. § 103:<sup>1</sup>

|                              |           |                  |
|------------------------------|-----------|------------------|
| Booth                        | 5,275,234 | January 4, 1994  |
| Onishi et al<br>(Onishi)     | 4,480,684 | November 6, 1984 |
| Han et al<br>(Han)           | 5,361,601 | November 8, 1994 |
| Fujimoto et al<br>(Fujimoto) | 63-172893 | July 16, 1988    |

Uchida et al (Symposium), "Heat Transfer Coefficient of HFC's Non-Azeotropic Refrigerant Mixtures in a Horizontal Grooved Tube" 30th National Heat Transfer Symposium of Japan, Vol. 1 (May 5, 1993), pp. 33-339.

The following rejections under 35 U.S.C. § 103 are before

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<sup>1</sup>Our understanding of the Japanese language references is derived from translations prepared in the Patent and Trademark Office. Copies of the translations are attached to this opinion.

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us for review:

1) claims 1, 2, 4 and 5, unpatentable over Fujimoto in view  
of Booth;

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2) claims 6, 7, 9-11, 13 and 14, unpatentable over Fujimoto in view of Booth and Onishi;

3) claims 15, 24 and 25, unpatentable over Fujimoto in view of Booth, Onishi, and Symposium;

4) claim 26, unpatentable over Fujimoto in view of Booth, Onishi, and Han; and

5) claims 27 and 28, unpatentable over Fujimoto in view of Booth, Onishi, Symposium and Han.

The rejections are explained in the examiner's answer (Paper No. 20, mailed September 29, 1998).

The opposing viewpoints of appellants are set forth in the brief (Paper No. 19, filed July 2, 1998).

#### *Opinion*

With reference to appellants' Figure 10, independent claim 1 is directed to a heat exchanger tube configured to have

an inner surface having a convex portion [7] having a tip which has a predetermined area, and a plurality of inner fins [9] each having a tip, the area of the tip of the convex portion being larger

*than that of the tip of the inner fins, wherein the cross-sectional shapes of the convex portion and the inner fins are asymmetrical so that the flow resistances are different for different flow directions of a refrigerant through the tube.*  
[Emphasis added.]

Fujimoto, the primary reference in the examiner's rejection, is similar to appellants' heat exchanger tube in the sense that both have internal ribs, and in the sense that both are designed to be mounted in holes of thin metal sheets by an expansion process that includes forcing a mandrel through the tubes to mechanically expand them into tight engagement with the holes of the sheets. Further, both Fujimoto and appellants provide a relatively large convex portion (appellants' element (7), Fujimoto's element (6)) on the inner surface of the tube for the purpose of taking up expansion forces of the mandrel and preventing the smaller, more delicate inner fins (appellants' element (9), Fujimoto's element (7)) from being detrimentally deformed by the mandrel. See, for example, the paragraph spanning pages 5 and 6 of the attached translation of Fujimoto.

Booth, the secondary reference in the examiner's rejection, also pertains to an internally ribbed heat exchanger tube that

is designed to be mounted by the aforementioned expansion process. In Booth, all of the internal ribs are the same, that is, Booth does not provide any relatively large convex portion (such as element (6) of Fujimoto) for taking up expansion forces. Booth states that the expansion process causes problems when mounting ribbed tubes of the type disclosure therein. Specifically, Booth states that "with rifle tube [i.e., an internally ribbed tube] the stress caused by the expansion process is increased in the thin part of the tube wall, causing the tube to split if there is even a minimal defect in the tube" (column 2, lines 15-18). Booth contends however, that by "increasing the amount of wall available (bottom wall to fin wall ratio)<sup>[2]</sup> to accommodate the required expansion, the likelihood of the tube splitting can be reduced" (column 2, lines 19-22). Concerning this splitting phenomenon, Booth states that "[it] is believed to be due to the necessity for sections of the tube between the fins to accommodate the stretch required by the expansion process, which necessarily caused

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<sup>2</sup>Booth defines the terms "bottom wall distance" and "fin wall distance" in the paragraph spanning columns 3 and 4.

increased stress to these areas of the wall" (column 2, line 67 through column 3, line 2). Concerning the configuration of the fins, Booth states the following:

As shown in FIG. 2 and in these and other preferred embodiments, the apex angle of fin 26 is *preferably asymmetrical* with respect to a radius 32 of the circular transverse cross-sectional shape. Such radius 32 intersects a spirally disposed fin 26 to form respective angles of approximately 13° and approximately 15° with regard to sloped sides 28,30 of the inverted V-shaped fin 26. In such a manner, sloped sides 28,30 of the inverted V-shaped fin 26 do not in these preferred embodiments slope down at the same angle with respect to inner surface 16 of tubular member 10. Accordingly, the shape of the several spiral grooves 24 between the spirally disposed fins 26 is that of an irregular trapezoid, as shown in FIG. 2. [Column 4, lines 14-26; emphasis added.]

The essence of the examiner's rejection of claim 1 is that, although Fujimoto does not disclose the convex portion (6) and inner fins (7) of the heat exchanger tube as being asymmetrical in cross-sectional shape, it would have been obvious to one of ordinary skill in the art to so shape these elements of Fujimoto's tube in view of the teachings of Booth.

However, appellants argue on page 5 of the brief that Booth proposes to overcome the tendency of the tube to split by increasing the amount of wall available to be stretched by

increasing the bottom wall to fin wall ratio. Appellant also correctly points out that the shape of Booth's fins is nowhere characterized as contributing to the split resistance of the tube, and that the small fins of Fujimoto are not deformed to any appreciable extent during the expansion process.<sup>3</sup>

Appellant's arguments are well taken. From our perspective, Booth teaches increasing the amount of wall available between the fins (i.e., increasing the "bottom wall to fin wall ratio") as a way of preventing the tube from splitting during the expansion process. It is unclear to us from Booth's disclosure why Booth "prefers" that the fins be asymmetrical, but, in contrast to the examiner, we do not read Booth's disclosure as requiring this type of fin configuration as a prerequisite to increasing the amount of wall available between the fins. Accordingly, like appellants, we find no motivation, either express or implied, within the teachings of the applied references for modifying Fujimoto in a manner that would result

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<sup>3</sup>Appellant also asserts (brief, page 6) that the shape of the fins in Booth is believed to be for the purpose of holding their shape, an assertion with which we do not necessarily agree.

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in the subject matter of claim 1. In this regard, even looking at Booth in a light most favorable to the examiner, that is, as showing that it is generally known in the heat exchanger art to provide internally ribbed heat exchanger tubes with asymmetrical fins, the rejection is not sustainable. This is so because, as best, Booth would have suggested that one of Fujimoto's internal formations, either the convex portions (6) or the fins (7), might be asymmetrical. In contrast, claim 1 calls for both the convex portion and the fins to be asymmetrical.

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In light of the foregoing, we will not sustain the examiner's rejection of claim 1, or claims 2, 4 and 5 which depend therefrom, as being unpatentable over Fujimoto in view of Booth.

The examiner has rejected claims 6, 7, 9-11, 13 and 14 as being unpatentable over Fujimoto in view of Booth and Onishi, and claim 15 as being unpatentable over Fujimoto in view of Booth, Onishi, and Symposium. Like claim 1, each of these claims requires the cross-sectional shapes of the convex portion and the inner fins to be asymmetrical so that the flow resistances are different for different flow directions of a refrigerant through the tube. We have carefully considered the Onishi and Symposium references additionally applied by the examiner against these claims but find nothing therein that makes up for the deficiencies of Fujimoto and Booth discussed above. Therefore, we also will not sustain the examiner's rejections of these claims.

Claims 24 and 25 stand rejected as being unpatentable over Fujimoto in view of Booth, Onishi, and Symposium. Appellants

argue on page 8 of the brief that the rejection of these claims should be reversed for the reasons expressed with respect to claims 1, 2, 4-7, 9-11 and 13-15. However, claims 24 and 25 do not include the limitation that the cross-sectional shapes of the convex portion and the inner fins are asymmetrical. Therefore, appellants' argument with respect to claims 24 and 25 fails at the outset because it is predicated on limitations that do not appear in the claims. See *In re Self*, 671 F.2d 1344, 1348, 213 USPQ 1, 5 (CCPA 1982). Since appellants have not presented any other arguments as to why the rejection of claims 24 and 25 is improper, the rejection of claims 24 and 25 will be sustained.<sup>4</sup>

Claims 26 depends from claim 11 and stands rejected as being unpatentable over Fujimoto in view of Booth, Onishi and

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<sup>4</sup>We note in passing that we are in agreement with the examiner's bottom line conclusion that the fin height to mean inner diameter ratio limitation of claim 24, the helical angle limitation of claim 26, and the zeotropic refrigerant limitation of both claims 24 and 26, are taught or suggested by the applied prior art. For example, see (1) page 4 of the translation of Fujimoto for its teachings regarding fin height and inner diameter, (2) Booth (column 1, lines 45-53) and Onishi (column 2, lines 18-19) for their teachings regarding helical angles, and Symposium for its general disclosure regarding the use of zeotropic refrigerants.

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Han. Claims 27 and 28 depend from claims 24 and 26, respectively, and stand rejected as being unpatentable over Fujimoto in view of Booth, Onishi, Symposium and Han.

With respect to claim 26, this claim, because of its dependency on claim 11, requires that the heat exchanger tube of the heat exchanger includes a convex portion and inner fins that are asymmetrical. In that the reference to Han additionally relied upon by the examiner in the rejection of this claim does not make up for the deficiencies of Fujimoto, Booth and Onishi in this respect, the rejection of claim 26 cannot be sustained.

Moreover, each of claims 26-28 calls for a refrigerating circuit capable of operating in a heating mode or a cooling mode and including a heat exchanger wherein, in the heating mode, the heat exchanger functions as an evaporator and the flow resistance therethrough is low, and, in the cooling mode, the heat exchanger functions as a condenser and the flow resistance therethrough is high. Thus, these claims *tie the mode of operation of the circuit and the corresponding functioning of the heat exchanger to flow resistance through the heat*

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*exchanger*. Because we find no teaching, suggestion or inference in any of the applied references for providing a low flow resistance through the heat exchanger when it functions as an evaporator in the heating mode, and for providing a high flow resistance through the heat exchanger when it functions as a condenser in the cooling mode, these rejections cannot be sustained.

In summary, the standing § 103 rejection of claims 24 and 25 is affirmed. All other rejections are reversed.

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No time period for taking any subsequent action in  
connection with this appeal may be extended under 37 CFR  
1.136(a).

*AFFIRMED-IN-PART*

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|-----------------------------|---|-----------------|
| LAWRENCE J. STAAB           | ) |                 |
| Administrative Patent Judge | ) |                 |
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|                             | ) |                 |
|                             | ) | BOARD OF PATENT |
| JEFFREY V. NASE             | ) | APPEALS AND     |
| Administrative Patent Judge | ) | INTERFERENCES   |
|                             | ) |                 |
|                             | ) |                 |
| JOHN F. GONZALES            | ) |                 |
| Administrative Patent Judge | ) |                 |

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